GLOSSARY

Section I. ACRONYMS AND ABBREVIATIONS

ABS . . . . . American Bureau of Shipping
ABT . . . . . automatic bus transfer
AC . . . . . alternating current
adj . . . . . adjustment
alt . . . . . alternate
amp . . . . . ampere
ANSI . . . . . American National Standard Institute, Inc.
assm . . . . . assembly
auto . . . . . automatic
avg . . . . . average
AWG . . . . . American wire gauge

bat . . . . . battery
BDU . . . . . battle dress uniform

CEMF . . . . . counter electromotive force
COMA . . . . . circular mil area
comm . . . . . communication
cond . . . . . condition
CPR . . . . . .Cardiopulmonary resuscitation
CS . . . . . centrifugal switch

DC . . . . . direct current
distr . . . . . distribution
DPDT . . . . . double-pole, double-throw
DPST . . . . . double-pole, single-throw

EFC . . . . . electronic fuel control
elf . . . . . efficiency
EMF . . . . . electromotive force
exc . . . . . exciter

FLC . . . . . .full-load current

H . . . . . henry
HP . . . . . horsepower
Hz . . . . . hertz

IEEE . . . . . Institute of Electric and Electronics Engineers

kHz . . . . . kilohertz
kV . . . . . kilovolt
kVa . . . . . apparent power (thousands of volts x amps)
KW . . . . . kilowatt (true power)
kWh . . . . . kilowatt hour

LCD . . . . . liquid crystal display
LCM . . . . . landing craft, mechanized
LCU . . . . . landing craft, utility
LED . . . . . light-emitting diode
LSV . . . . . logistics support vessel
ltg . . . . . lighting

mA . . . . . milliampere
max . . . . . maximum
MCC . . . . . motor control center
mfr . . . . . manufacturer
mho . . . . . unit of conductance
MOS . . . . . military occupational specialty
MPU . . . . . magnetic pickup
mV . . . . . millivolt

NC . . . . . normally closed
NEC . . . . . National Electrical Code
NEMA. . . . . National Electrical Manufacturers Association
NICAD . . . . . nickel-cadmium

NO . . . . . normally opened

OBA . . . . . oxygen breathing apparatus

PF . . . . . power factor
PMG . . . . . permanent magnet generator
press . . . . . pressure
psia . . . . . pounds per square inch atmospheric
psig . . . . . pounds per square inch gauge
PVC . . . . . polyvinyl chloride

RF . . . . . radio frequency
rheo. . . . . rheostat
rm . . . . . room

RMS. . . . . root mean square
RPM . . . . . revolutions per minute

SPST . . . . . single-pole, single-throw
SW . . . . . switch

temp . . . . . temperature

uA . . . . . microampere
uV . . . . . microvolt

VA . . . . . volt-ampere (apparent power)
VAC . . . . . volts alternating current
VAR . . . . . volt-amperes reactive
VDC . . . . . volts direct current

Section II. TERMS

accuracy - limitation that a measurement may vary from its true value; usually represented as a percentage of full scale, such as +1%.

across-the-line starter - starting a motor when connected directly to the supply lines.

active power - true electrical power; power that is actually doing work.

air-core transformer - a transformer composed of two or more coils that are wound around a nonmetallic core.

air gap - the air space between two magnetically or electrically related components for example, the space between the armature and poles in a motor.

alternating current - an electrical current that constantly changes amplitude and changes in polarity at regular intervals.

alternator - device mounted on a diesel engine to charge starting batteries; sometimes used as a term for alternating current generators.

ambient temperature - average temperature of the air surrounding an electrical device; usually expressed in degrees Celsius (C).

ammeter - an instrument for measuring the amount of electron flow in amperes.

ampere - the basic unit of electrical current.

amplification - production of an output larger than the corresponding input.

amplifier - an electrical device producing an output signal larger than its input signal.

analog device - device that measures continuous information (voltage, current). The analog has an infinite number of possible values; its limitation is the accuracy of the measuring device. It uses a meter with a needle and scale.

analog signal - a signal having a continuous and smooth signal over a given range.

AND logic - control circuits where all inputs must have a signal for the circuit to operate. For example, with two NO inputs in a series, both must be closed to energize the circuit.

anode - a positive electrode of an electromagnetic device, such as a primary or secondary electric cell, toward which the negative ions are drawn.

apparent power - that power apparently available for use in an AC circuit containing a reactive element. It is the product of effective voltage times effective current expressed in volt-amperes. It must be multiplied by the power factor to obtain true power available.

arc chute - cover around contacts to prevent arcs from reaching surrounding parts.

arc hood - separate cover over a relay. The function is the same as an arc chute.

armature - a winding that has an EMF induced (or produced) into it.

armature reaction - reaction of the magnetic field coils to the magnetic field produced by current in the armature windings of a DC generator.

attraction - the force that tends to make two objects approach each other. Attraction exists between two unlike magnetic poles (north and south) or between two unlike static charges (plus and minus).

automatic controller - a motor control device that uses automatic pilot devices to turn the circuit on and off.

autotransformer - a transformer with a single coil. The entire length of the coil acts as a primary winding; only part of the winding functions as a secondary winding. It is used primarily as a device to reduce inrush current for motor starting.

average value of AC - The average of all instantaneous values of one-half cycle of alternating current.

AWG (American wire gauge) - a standard for wire size used by industry, replaced by the circular mil by the military.

back voltage - a term sometimes used to refer to counter EMF.

battery - a device for converting chemical energy into electrical energy.

battery capacity - the amount of energy available from a battery. Battery capacity is expressed in ampere-hours.

blowout coil - a coil in a relay used to stretch the arc (blow it out) when opening.

branch - an individual current path in a parallel circuit.

brush - a sliding contact, normally made of carbon, and riding on a commutator or slip ring to provide a mechanical contact between the rotating and stationary portions of an electrical device.

capacitance - the property of an electrical circuit that opposes changes in voltage.

capacitive reactance - the opposition offered to the flow of alternating current by capacitance, expressed in ohms. The symbol for capacitive reactance is X_C.

capacitor - an electrical device capable of storing electrical energy in an electrostatic field.

capacitor start motor - an alternating current split-phase motor using a capacitor to achieve a phase shift between the start and run windings. It uses a centrifugal switch to disconnect the start winding when the motor achieves between 75 and 90 percent running speed.

cathode - the general name for any negative electrode.

cell - a single unit that transforms chemical energy into electrical energy. Batteries are made up of cells.

charge - represents electrical energy. A material having an excess of electrons is said to have a negative charge. A material having an absence of electrons is said to have a positive charge.

charge cycle - the period of time that a capacitor in an electrical circuit is storing a charge.

choke - a coil used in a direct current circuit to smooth out ripples or a pulsating waveform.

circuit - the complete path of an electric current.

circular mil - an area equal to that of a circle with a diameter of 0.001 inch. It is used for measuring the cross-sectional area of wires.

coil - an inductive device created by looping turns of wire around a core.

combination circuit - a series-parallel circuit.

commutator - a segmented bar section on an armature providing a place for the brushes to make contact with the armature windings.

compensating windings - windings embedded in the face of the pole pieces of a DC machine to oppose armature reaction and control arcing at the brushes.

compound generator - a generator using both series and shunt windings on each pole piece.

compound motor - direct current motor with both series and shunt windings.

conductance - the ability of a material to conduct or carry an electric current. It is the reciprocal of resistance of the material and is expressed in mhos or siemens.

conductivity - ease with which a substance transmits electricity.

conductor - a material with a large number of free electrons; a material that permits electric current to flow.

control point - the level at which a system will be maintained (such as temperature and pressure).

control voltage - voltage level used in a control circuit to actuate coils and other devices.

controller - a device for starting a motor in either direction of rotation or adjusting the speed of rotation.

copper loss (I^2R loss) - the power lost due to the resistance of the conductors. In transformers, the power is lost because of current flow (I) through the resistance (R) of the windings.

core - any material that affords a path for magnetic flux lines in a coil.

coulomb - a measure of the quantity of electricity. One coulomb equals 6.242 x 1,018 electrons.

Coulomb's Law - also called the law of electric charges or the law of electrostatic attraction. Coulomb's Law states charged bodies attract or repel each other with a force that is directly proportional to the product of their individual charges and inversely proportional to the square of the distance between them.

counter EMF (counter electromotive force) - an electromotive force (voltage) induced in a coil that opposes applied voltage; voltage induced in the coils of a load.

coupling, coefficient of - an expression of the extent to which two inductors are coupled by magnetic lines of force. This is expressed as a decimal or percentage of maximum possible coupling and represented by the letter K.

cross-sectional area - the area of a slice of an object. When applied to electrical conductors, it is usually expressed in circular mils.

current - the drift of electrons pasta reference point; the passage of electrons through a conductor. It is measured in amperes.

current, inrush - current flowing into a circuit immediately upon energizing the circuit. It is normally used in conjunction with inductive loads.

cycle - one complete positive and one complete negative alternation of a current or voltage.

damper windings - windings embedded in the pole pieces of generators used to oppose changes in frequency or speed of the rotor. They allow generators to remain in parallel operation.

dead short - a short circuit having minimum resistance.

delta connection - three-phase circuit where the windings are connected in the form of a closed ring or end to end. It is often used to connect windings in three-phase transformers and motors.

delta-delta connection - a transformer connection where both the input and output windings are delta-connected.

delta-wye connected - a transformer connection where the input is delta-connected and the output is wye-connetted.

dielectric - an insulator; the insulating material between the plates of a capacitor.

dielectric constant - the ratio of capacitance of a capacitor with a dielectric between the electrodes to the capacitance of a capacitor with air between the electrodes.

dielectric field - the space between and around charged bodies in which their influence is felt; also called electric field of force or electrostatic field.

dielectric hysteresis loss - power loss of a capacitor due to the changes in orientation of electron orbits in the dielectric caused by rapid reversal in polarity of line voltage. The higher the frequency, the greater the loss.

dielectric leakage - power loss of a capacitor due to leakage of current through the dielectric. It also relates to leakage resistance. The higher the leakage resistance, the lower the dielectric leakage.

digital - a class of devices in which outputs vary in discreet or distinct steps, such as pulses; test equipment that displays readingds in the form of LCD or LED readouts.

direct current - an electric current that flows in one direction.

displacement current - the current that appears to flow through a capacitor.

domain theory - a theory of magnetism based upon the electron-spin principle. Spinning electrons have a magnetic field. If more electrons spin in one direction than another, the atom is magnetized.

doping - the process in which a crystalline structure is altered by replacing existing atoms with those atoms from other elements. For example, germanium and silicon are base elements used in electronics. To give these base elements a more positive or negative quality, bismith or boron atoms can be added, respectively.

dot notation - a system used by drafters to indicate relative instantaneous polarity in AC motor and transformer windings.

drum switch - a type of motor controller using switches in the form of fingers actuated by a cam to control various contractors in a control circuit. It is usually used in reversing or braking controllers.

dry cell - an electric cell in which the electrolyte is not a liquid. In most dry cells, the electrolyte is in paste form.

dynamic braking - braking a motor by using the motor as a generator and dissipating the generated voltage through resistors. Dynamic braking uses motor reaction to slow the motor.

eddy current - induced circulating currents in a conducting material that are caused by a varying magnetic field.

eddy current loss - losses caused by random current flowing in the core of a transformer. Power is lost in the form of heat.

effective value - same as root mean square.

efficiency - the ratio of output power to the input power; generally expressed as a percentage.

electric current - electric energy stored on or in an object. It is the negative charge caused by an excess of electrons or the positive charge caused by a deficiency of electrons. Its symbol is Q, q.

electrochemical - the action of converting chemical energy into electrical energy.

electrode - the terminal at which electricity passes from one medium into another, such as in an electrical cell where the current leaves or returns to the electrolyte.

electrolyte - a solution of a substance that is capable of conducting electricity; may be either a liquid or a paste.

electromagnet - an electrically excited magnet capable of exerting mechanical force or performing mechanical work.

electromagnetic - describes the relationship between electricity and magnetism, having both magnetic and electrical properties.

electromagnetic induction - the production of a voltage in a coil due to a change in the number of magnetic lines of force (flux linkages) passing through the coil.

electromagnetism - the generation of a magnetic field around a current-carrying conductor.

electron - the elementary negative charge that revolves around the nucleus of an atom.

electron shell - a group of electrons that have a common energy level that forms part of the outer structure (shell) of an atom.

electrostatic - pertaining to electricity at rest, such as charges on an object (static electricity).

electrostatic field - the field of influence between two charged bodies.

element - a substance in chemistry that cannot be divided into simpler substances by any means normally available.

EMF (electromotive force) - the force that causes electricity to flow between two points with different electrical charges; or when there is a difference in potential between the two points, the unit of measurement in volts.

energy - the ability or capacity to do work.

equivalent resistance - a resistance that represents the total ohmic values of a circuit component or group of circuit components. It is usually drawn as a single resistor when simplifying complex circuits.

excitation - creating a magnetic field; passing current through a conductor to create an electromagnetic field.

excitation current - the current that produces the magnetic field in a generator; the current that flows in the primary winding of a transformer, which produces a magnetic flux field. It is also called magnetizing current.

farad - the basic unit of capacitance. A capacitor has a capacitance of 1 farad when a voltage change of 1 volt per second across it produces a current of 1 ampere.

ferromagnetic material - a highly magnetic material, such as iron, cobalt, nickel, or alloys.

field - the winding in rotating machines that accounts for the magnetic properties necessary to induce an EMF.

field intensity - the amount of magnetizing force available to produce flux lines in the core of a magnet.

field of force - describes the total force exerted by an action-at-a-distance phenomenon, such as gravity upon matter, electric charges acting upon electric charges, and magnetic forces acting on other magnets or magnetic materials.

filter - device used to smooth a signal; electrical device used to suppress undesired noise.

fixed resistor - a resistor having a definite resistance value that cannot be adjusted.

flashing the field - passing current through the windings of a field oil to establish residual magnetism.

flat compounded generator - a compound generator wound so that the series and shunt fields produce an almost constant voltage output for current values from no load to full load.

flux - in electrical or electromagnetic devices, a general term used to designate collectively all the electric or magnetic lines of force in a region.

flux density - the number of magnetic lines of force passing through a given area.

frequency (f) - the number of complete cycles per second existing in any form of wave motion, such as the number of cycles per second of an alternating current.

gaseous - one of the four states of matter; having no fixed shape or volume. For example, steam is a gas.

generator - a rotating machine that uses magnetic induction to produce an EMF, converting mechanical energy into electrical energy.

generator action - inducing a voltage into a wire that is cutting across magnetic lines of force.

graph - a pictorial presentation of the relationship between two or more variable quantities, such as between applied voltage and current it produces in a circuit.

ground - an electrical or mechanical connection, either intentional or accidental, connected from a conductor to earth. The conductor may or may not carry current.

ground potential - zero potential with respect to the ground or earth.

heat sink - a piece of metal used to mount components and draw heat away from them. It is usually made of finned aluminum.

henry (H) - the electromagnetic unit of inductance or mutual inductance. The inductance of a circuit is 1 henry when a current variation of 1 ampere per second induces 1 volt. It is the basic unit of inductance. In radio, smaller units are used, such the millihenry (mH), which is one-thousandth of a henry (H), and the microhenry (uH), which is one-millionth of a henry.

hertz (Hz) - a unit of frequency equal to one cycle per second.

high side - in a transformer, designates the high voltage coil.

horsepower - the English unit of power, equal to work done at a rate of 550 foot-pounds per second, equal to 746 watts of electrical power.

horseshoe magnet - a permanent magnet bent into the shape of a horseshoe or having a U-shape to bring the two poles near each other.

hydrometer - an instrument used to measure specific gravity. In batteries, hydrometers are used to indicate the state of charges by the specific gravity of the electrolyte.

hysteresis - the time lag of the magnetic flux in a magnetic material behind the magnetizing force producing it; caused by the molecular friction of the molecules trying to align themselves with the magnetic force applied to the material.

hysteresis loss - the power loss in an iron-core transformer or other alternating-current device as a result of magnetic hysteresis.

impedance - the total opposition offered to the flow of an alternating current. It may consist of any combination of resistance, inductive reactance, and capacitive reactance. The symbol for impedance is Z.

inching - applying reduced power to a motor to move a motor or its load slowly to a desired position.

induced charge - an electrostatic charge produced on an object by the electric field that surrounds a nearby object.

induced current - current that flows in a conductor because of a changing magnetic field.

induced electromotive force - the electromotive force induced in a conductor due to the relative motion between a conductor and a magnetic field.

induced voltage - see induced electromotive force.

inductance - the property of a circuit that tends to oppose a change in the existing current flow. The symbol for inductance is L.

induction - the act or process of producing voltage by the relative motion of a magnetic field across a conductor.

inductive coupling - coupling of two coils by means of magnetic lines of force. In transformers, it is coupling applied through magnetic lines of force between the primary and secondary windings.

inductive reactance - the opposition to the flow of an alternating current caused by the inductance of a circuit, expressed in ohms. It is identified by the letter X.

in phase - applied to the condition that exists when two waves of the same frequency pass through their maximum and minimum values of like polarity at the same instant.

infinite - extending indefinitely, endless; boundless having no limits; an incalculable number.

instantaneous value - the magnitude at any particular instant when a value is continually varying with respect to time.

insulation - a material used to prevent the leakage of electricity from a conductor and to provide mechanical spacing or support to protect against accidental contact; a material in which current flow is negligible, used to surround or separate a conductor to prevent loss of current.

insulator - material of such low conductivity that the flow of current through it can usually be neglected; device having high-electrical resistance, used for supporting or separating conductors so as to prevent undesired flow of current from the conductors to other objects.

integrated circuit - a solid state circuit made up of transistors, resistors, and similar components. All components are packaged into a single device called a chip or one piece of semiconductor material.

interlock - mechanical connection between electrical devices. It may be used to open and close contacts together or prevent components from energizing together.

interpole - a separate winding and pole piece, connected in series and 180 degrees out of phase with the armature of a DC machine. It is used to oppose armature reaction.

inversely - inverted or reversed in position or relationship.

inverter - circuit that changes direct current into alternating current.

ion - an electrically charged atom or group of atoms. Negative ions have an excess of electrons, positive ions have a deficiency of electrons.

ionize - to make an atom or molecule of an element lose an electron, as by X-ray bombardment, and thus be converted into a positive ion. The freed electron may attach itself to a neutral atom or molecule to form a negative ion.

isolation - separation; the value of insulation resistance, measured between the input and output, input to case, or output to case.

jogging - rapid application of full power to a motor to move it or its load into position desired.

junction - the connection between two or more conductors; the contact between two dissimilar metals or materials, as is in the thermocouple.

kilo - a prefix meaning one thousand.

kinetic energy - energy that a body possesses by virtue of its motion.

Kirchhoff's Laws - the talebearing sum of the currents flowing toward any point in an electrical network is zero; the algebraic sum of the products of the current and resistance in each of the conductors at any closed path in a network equals the algebraic sum of the electromotive forces in the path.

lag - the amount one wave is behind another in time, expressed in electrical degrees.

laminated core - a core built up from thin sheds of metal insulated from each other and used in transformers.

law of magnetism - like poles repel; unlike poles attract.

lead - the opposite of lag; also a wire or connection.

lead-acid battery - a cell in an ordinary storage battery, in which electrodes are grids of lead containing an active material consisting of certain lead oxides that change composition during charging and discharging. The electrodes are plates that are immersed in an electrolyte of diluted sulfuric acid.

leakage flux - magnetic lines of flux produced by the primary winding that do not link the turns of the secondary winding.

leakage resistance - the electrical resistance that opposes the flow of current through the dielectric of a capacitor. The higher the leakage resistance, the slower the capacitor will discharge or leak across the dielectric.

left-hand rule for generators - a rule or procedure used to determine the direction of current flow in a generator.

Lenz's Law - the current induced in a circuit due to its motion in a magnetic field or to a change in its magnetic flux in such a direction as to exert a mechanical force opposing the motion or to oppose the change in flux.

light-emitting diode (LED) - a diode that emits light when energized in a forward bias; may be used as a control device or in a digital display.

line diagram - industry standard method of representing control circuits. It is also called a ladder diagram.

lines of force - a lime in an electric or magnetic field that shows the direction of the force.

liquid - one of the four states of matter that has a definite volume but no definite form. For example, water is a liquid.

liquid crystal display (LCD) - a semiconductor device used for displaying digital readouts.

load - a device through which an electric current flows and that changes electrical energy into another form; power consumed by a device or circuit in performing its function.

local action - a continuation of current flow within an electrical cell when there is no external load. It is caused by impurities in the electrode.

locked rotor current - the current level in the motor the instant power is applied, before the motor starts to turn and build CEMF. It is the maximum current level in a motor in good condition.

locked rotor torque - the torque developed by the motor as it is first energized; the greatest amount of torque a motor produces.

logic - a method of using the symbols AND, OR, NAND, NOR, and NOT to represent the function of a circuit.

low side - the low voltage side of a transformer.

magnetic contactor - a switching device actuated by a magnetic coil. It is usually used in AC circuits.

magnetic field - region in which the magnetic forces created by a permanent magnet or by a current-carrying conductor or coil can be detected.

magnetic lines of force - imaginary lines used for convenience to designate the direction in which magnetic forces are acting as a result of magnetomotive force.

magnetic motor starter - a magnetic contactor with an overload section added. It is used to start AC motors.

magnetic poles - the section of a magnet where the flux lines are concentrate also where they enter and leave the magnet.

magnetism - the property possessed by certain materials by which these materials can exert mechanical force on neighboring masses of magnetic materials and can cause currents to be induced in conducting bodies moving rotative to the magnetized bodies.

magnetomotive force - the force that produces magnetic lines of force in a magnetic circuit.

matter - any physical entity that possesses mass.

mechanical energy - in moving objects, the force of motion they possess.

mega - a prefix meaning one millon.

memory - characteristic of a motor control circuit that makes it continue to follow the last input; the part of a programmable controller where data and instructions are stored.

mho - unit of conductance; the reciprocal of the ohm.

micro - a prefix meaning one-millionth.

microfarad - one-millionth of a farad. It is the most commonly used unit of measurement of capacitors for motor starting.

microprocessor - a central computer unit that processes input information.

milli - a prefix meaning one-thousandth.

motor controller - device used in a motor circuit to control starting, stopping, direction, breaking, overloads, and inrush current.

motor efficiency - ratio of input power to output power.

motor reaction - magnetic reaction developed in a generator as the armature windings are energized. As the armature builds current and a magnetic field, it reacts with the energized field windings, opposing the generator's direction of rotation.

mutual flux - The total flux in the core of a transformer that is common to both the primary and the secondary windings. The flux links both windings.

mutual inductance - a circuit property existing when the relative position of two inductors causes the magnetic lines of force from one to link with the turns of another. The symbol for mutual inductance is M.

NAND logic - circuit where there are two or more NC inputs in parallel.

NEC (National Electrical Code) - regulatory guidance for electrical devices and shore installations.

negative alternation - the negative half of an AC waveform.

negative electrode - a terminal or electrode having more electrons than normal. Electrons flow out of the negative terminal of a voltage source.

negative temperature coefficient - the temperature coefficient expressing the amount of reduction in the value of a quantity, such as resistance for each degree of increase in temperature.

NEMA (National Electrical Manufacturers Association) - organization that standardizes electrical devices.

network - a combination of electrical components. In a parallel circuit, it is composed of two or more branches.

neutral - in a normal condition, hence neither negative or positive. A neutral object has a normal number of electrons.

neutron - one of the principle parts of the atom. It has no electrical charge and is found in the nucleus of the atom.

newton - metric unit of measure of force. The symbol is N. It is the force that causes a kilogram of mass to accelerate at 1 meter per second. It equals about ¼ pound.

node - used to indicate an electrical connection of two of more conductors. An electrical node can be considered to extend throughout the circuit where all connections, components, switches, and conductors maintain the same source potential.

no-load condition - the condition that exists when an electrical source or the secondary of a transformer is operated without an electrical load.

no-load test - test of a motor or generator with no electrical load on the device.

NOR logic - two or more NC contacts in series, such as multiple stop buttons.

normally closed (NC) contacts - a set of contacts that are closed in the resting position (no outside force applied).

normally open (NO) contacts - a set of contacts that are open in the resting position (no outside force applied).

NOT logic - a single NC contact in a circuit.

ohm - the unit of electrical resistance. It is that value of electrical resistance through which a constant potential difference of 1 volt across the resistance will maintain a current flow of 1 ampere through the resistance.

Ohm's Law - the current in an electrical circuit is directly proportional to the electromotive force in the circuit. The most common form of the law is E = IR, where E is the electromotive force or voltage across the circuit, I is the current flowing in the circuit, and R is the resistance in the circuit.

open circuit - the condition of an electrical circuit caused by the breaking of continuity of one or more of the conductors of the circuit, usually an undesired condition; a circuit that does not provide a complete path of current flow.

OR logic - two or more NO inputs in parallel; either input will energize the load.

out of phase - two or more phases of alternating current that are changing in direction and amplitude at different times.

over compounding - in a compound wound machine, placing more emphasis on the series winding and the series characteristics.

overload relay - a device for protecting electrical circuits and loads from excess current levels. They may be magnetic, thermal, or bimetallic type.

parallel circuit - two or more electrical devices connected to the same pair of terminals so separate currents flow through each. Electrons have more than one path to travel from the negative to the positive terminal.

peak to peak - the measure of absolute magnitude of an AC waveform, measured from the greatest positive alternation to the greatest negative alternation.

peak value - the highest value, either positive or negative, in an alternating current system.

period time - the time required to complete one cycle of a waveform.

permanent capacitor motor - a single-phase motor using a capacitor to create a phase shift in one set of windings.

permanent magnet - a magnet that retains its magnetic properties indefinitely.

permeability - the measure of the ability of a material to act as a path for magnetic lines of force.

phase - the angular relationship between two alternating currents or voltages when the voltage or current is plotted as a function of time. When the two are in phase, the angle is zero and both reach their peak simultaneously. When out of phase, one will lead or lag the other. At the instant when one is at its peak; the other will not beat peak value and (depending on the phase angle) may differ in polarity as well as magnitude.

phase angle - the number of electrical degrees of lead or lag between the voltage and current waveforms in an AC circuit.

phase difference - the time in electrical degrees by which one wave leads or lags another.

phase sequence - the order in which the different phases rise to peak voltage. It may be ABC or CBA.

phase shift - creating a lag or lead in time between the current wave and the voltage wave in an alternating current system. Voltage is the constant.

phase voltage - voltage across a coil in a transformer or generator.

photoelectric voltage - a voltage produced by light.

piezoelectric voltage - the effect of producing a voltage by placing stress, either by compression, expansion, or twisting, on a crystal and, conversely, producing a stress on a crystal by applying a voltage to it.

plate - one of the electrodes in a storage battery.

polarity - the condtion in an electrical circuit by which the direction of the current flow can be determined, usually applied to batteries and other direct current voltage sources; two opposite charges, one positive and one negative, a quality of having two opposite poles, one north and one south.

polarization - the effect of hydrogen surrounding the anode of a cell that increases the internal resistance of the cell; the magnetic orientation of molecules in a magnetizable material in a magnetic field, whereby tiny internal magnets tend to lime up in the field.

polyphase - a multiple phase alternating current system. The term has been mostly replaced with the term "three-phase."

positive alternation - the positive half of an AC waveform.

potential energy - energy due to the position of one body with respect to another body or to the relative parts of the same body.

potentiometer - a three-terminal resistor with one or more sliding contacts, which functions as an adjustable voltage divider.

pounds of force - English unit of measure for power.

power - the rate of doing work or the rate of expending energy. The unit of electrical power is the watt.

power factor - the ratio of the actual power of an alternating or pulsating current, as measured by a wattmeter, to the apparent power, as indicated by ammeter and voltmeter readings. The power factor of an inductor, capacitor, or insulator is an expression of their losses.

primary cell - an electrochemical cell in which the chemical action eats away one of the electrodes, usually the negative electrode.

primary windings - the winding of a transformer connected to the power source.

prime mover - the driving force for a generator. It may be a diesel engine, a gas or steam turbine, or even an electric motor.

program - the sequence of instructions used to tell a computer how to operate.

prony brake - a device for loading a motor and measuring torque.

proton - one of the particles making up an atom and having a positive electrical charge. It may be found in the nucleus.

pulsating current - direct current that has been rectified from an alternating current. It has a waveform but does not generally drop below the zero plane.

radio frequency (RF) - any frequency of electrical energy capable of propagation into space.

ratio - the value obtained by dividing one number by another, indicating their relative proportions.

RC constant - time constant of a resistor-capacitor circuit; equal in seconds to the resistance value in ohms multiplied by the capacitance value in farads.

reactance - the opposition offered to the flow of an alternating current by the inductance, capacitance, or both in any circuit.

reactive load - a load developing reactive power, such as an inductive or capacitive load.

reciprocal - the value obtained by dividing the number 1 by any quantity.

rectification - the process of mechanically or electronically converting an alternating current into direct current.

rectifier - a device that changes alternating current into direct current.

reduced inrush starting - using motor starting circuits to limit inrush current.

reference point - a point in a circuit to which all other points in the circuit are compared.

regenerative braking - an inherent ability in a motor to generate a small current and develop motor reaction as the load slows when de-energized.

relay - an electromechanical device using a coil to actuate contacts to control current to a load. Normally, it is the term for magnetic devices in large direct current systems.

relay, solid-state - a solid-state switching device using a control signal to switch current on and off to a load.

reluctance - a measure of the opposition that a material offers to magnetic lines of force.

repulsion - the mechanical force tending to separate bales having like electrical charges or like magnetic polarity.

residual magnetism - magnetism remaining in a substance after removal of the magnetizing force.

resistance - the property of a conductor that determines the amount of current that will flow as the result of the application of a given electromotive force. All conductors possess some resistance, but when a device is made especially for the purpose of limiting current flow, it is called a resistor. A resistance of 1 ohm will allow current of 1 ampere to flow through it when a potential of 1 volt is applied. It is the opposition that a device or material offers to the flow of current. The effect of resistance is to raise the temperature of the material or device carrying the current. Resistance also refers to a circuit element designed to offer predetermined resistance to current flow.

resistive load - a load that converts electrical energy into heat or light; a load characterized by having virtually no inrush current.

resistor - the electrical component that offers resistance to current flow. It may be a coil of fine wire or a composition rod.

resonance - the condition existing in a circuit when values of inductance, capacitance, and the applied frequency are such that the inductive reactance and capacitive reactance cancel each other.

retentivity - the ability of a material to retain its magnetism.

reverse current relay - device in a DC switchboard that senses current being delivered to a generator and removes the generator from the circuit. This prevents the generator from being driven like a motor.

reverse polarity protection - devices used to protect generators from being driven like a motor.

reverse power relay - device in an AC switchboard that senses current being delivered to a generator and removes the generator from the circuit. This prevents the generator from being driven like a motor.

rheostat - a resistor whose value can be varied; a variable resistor that is used for the purpose of adjusting the current in a circuit.

ripple - a series of peaks in current or voltage value when alternating current has been rectified to direct current.

RLC circuit - an electrical circuit that has the properties of resistance, inductance, and capacitance.

root mean square (RMS) - the equivalent heating value of an alternating current or voltage, as compared to a direct current or voltage. It is 0.707 times the peak value of the same sine wave.

rotating armature generator - an alternating current generator having the output voltage generated in the rotating windinds (rotor).

rotating field generator - an alternating current generator using the rotating windings (rotor) as the field and having the output voltage developed in the stationary windings (stator).

rotational losses - power lost in rotating equipment due to windage and friction.

rotor - rotating windings or the rotating portion of AC machines.

salient pole - the pole pieces bolted to the shaft in AC generators.

saturation - the condition or point where a magnetic or electrical device can take no more magnetic flux.

saturation curve - a magnetization curve showing the relationship between current and magnetic flux.

schematic circuit diagram - a diagram using symbols to indicate devices in a circuit. Schematics show function, not location.

SCR (silicon-controlled rectifier) - a three-lead semiconductor used as a switching device. Normally an open circuit, when a signal is delivered to the gate, the device rapidly allows current to flow. It is an extremely rapid operation.

secondary - the output coil of a transformer.

secondary cell - a cell that can be recharged bypassing a current through the cell in a direction opposite to the discharge current.

self-excited - a generator that uses residual magnetism to develop its magnetic field and output voltage.

self-induction - the production of a counter electromotive force in a conductor when its own magnetic field collapses or expands with a change in current in the conductor.

separately excited - a generator that needs an outside power source to energize its field windings.

series aiding - when power sources are connected so the positive terminal of one source is connected to the negative terminal of another source. The voltage developed is the sum of the two voltages.

series circuit - an arrangement where electrical devices are connected so that the total current must flow through all the devices. Electrons have one path to travel from the negative to the positive terminal.

series field - a winding in a rotating machine that is connected in series with the armature of the machine.

series motor - a rotating machine with the field winding in series with the armature. It develops a high starting torque and may be either AC or DC.

series opposing - power sources that are connected positive terminal to positive terminal.

series-parallel circuit - a circuit that consists of both series and parallel networks.

shaded pole motor - a single-phase squirrel cage motor using slotted stator poles with copper bands to create a phase shift. The copper band creates an auxiliary winding and a slight delay in the magnetic field.

shading coil - a coil with a slotted pole piece wrapped with a copper band. The copper band causes a delay in the magnetic field. It may be used to create a rotating magnetic field or to keep AC contractors from chattering.

shelf life - the period of time that a cell or battery may be stored and still be useful.

shell-type transformer - a transformer using a coil constructed to surround the coil as well as pass through the center of the coil.

shielding - a metallic covering used to prevent magnetic or electromagnetic fields from affecting an object.

short circuit - a low-resistance connection between two points of different potential in a circuit, usually accidental and usually resulting in excessive current flow that may cause damage.

shunt - a parallel connection a device used with an ammeter to direct most of the current around the meter movement.

shunt field - afield coil in a DC machine connected in parallel with the armature.

shunt wound - a DC machine having the field coils in parallel with the armature windings.

shuttle power - power stored in the inductive or capacitive load and returned to the circuit.

siemens - the new and preferred term for conductance, replacing the mho.

sine wave - the curve traced by the projection on a uniform time scale of the end of a rotating arm or vector. It is also known as a sinusoidal wave.

single phase - an alternating current system using a single voltage and current sine wave.

slip - the difference in speed between synchronous speed and rotor speed.

slip rings - rings of copper on the rotor of an AC machine to provide a path of current from brushes to the rotor windings.

solder pot - the device in a thermal overload that holds the device in a normal operating condition. Heat generated by excess current causes the solder to melt, releasing springs that open the overload contacts.

solid - one of the four states of matter, which has a definite volume and shape. For example, ice is a solid.

solid-state - another term for electronic devices.

source of voltage - the device that furnishes the electrical energy used by a load.

specific gravity - the ratio between the density of a substance and that of pure water at a given temperature.

split-phase (resistance-start) motor - an induction motor using greater resistance in one winding to create the phase shift necessary for the motor to start.

squirrel cage rotor - a rotor using bars that are shorted at the ends. Current is induced into the rotor.

stall torque - the point at which the torque demanded of a motor exceeds the motor's torque output.

static electricity - stationary electricity that is in the form of a charge. It is the accumulated charge on an object.

stator - the stationary windings in an AC machine.

stator field - the magnetic field setup in the stator windings.

stroboscopic effect - used to measure speed of a rotating shaft. When a strobe light flashes on the shaft, the shaft will appear to stop if the flash speed and rotating speed are the same.

switch - a device to connect, disconnect, or change the connections in an electrical circuit.

synchronous - in step or in phase as applied to currents, voltages, or two different rotating machines.

synchronous speed - the rate of travel of a stator field of a three-phase machine; determined by the frequency and number of poles.

synchroscope - a device used to determine phased differences between two AC generators. It allows aligning phases of generators for parallel operation.

tapped resistor - a wire-wound fixed resistor having one or more additional terminals along its length, generally for voltage divider applications.

taps - terminals added to freed resistors to allow connections at various points along the resistor with varied values.

temperature coefficient - the amount of change of resistance in a material per unit change in temperature.

terminal - an electrical connection.

tesla - measure of flux density.

thermistor - a temperature-controlled variable resistor.

thermocouple - a junction of two dissimilar metals that produces a voltage when heated.

thermostat - a device in a control circuit used to start and stop air conditioning, refrigeration, or heating systems based on temperature.

theta - the Greek letter (θ) used to represent phase angle.

three-phase - alternating current devices using three sine waves, 120 electrical degrees out of phase.

time constant - the time required to charge a capacitor to 63.2 percent of maximum voltage or discharge to 36.8 percent of its final voltage. It is the time required for the current in an inductor to increase to 63.2 percent of maximum current or decrease to 36.8 percent of its final current.

timer - a control device that turns on or turns off a control circuit based a preset time delay.

tolerance - the maximum error or variation from the standard permissible in a measuring instrument; a maximum electrical or mechanical variation from specifications that can be tolerated without impairing the operation of the device.

torque - the force that produces a twisting or rotating action.

total resistance (Rt) - the equivalent resistance of an entire circuit. For a series circuit Rt = R1 + R2 + R3 + . . . Rn. For parallel circuits: $\frac{1}{Rt} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \ldots \frac{1}{Rn}$

transducer - a device that converts physical parameters, such as pressure and temperature, into an electrical signal.

transformer - a device composed of two or more coils, linked by magnetic lines of force, used to transfer energy from one circuit to another.

transformer efficiency - the ratio of output power to input power, generally expressed as a percentage:

$$\text{Efficiency} = \frac{P\ out}{Pin} \times 100$$

transformer, isolation - a transformer with the same number of turns in the primary and secondary windings. This construction will deliver the same voltage in the secondary winding as in the primary windings. Isolation transformers are used to protect circuits or portions of the distribution system.

transformer, step-down - a transformer so constructed that the number of turns in the secondary winding is less than the number of turns in the primary winding. This construction will provide less voltage in the secondary circuit than in the primary circuit.

transformer, step-up - a transformer so constructed that the number of turns in the secondary winding is more than the number in the primary winding. This construction will provide more voltage in the secondary winding than in the primary winding.

transient - a temporary current or voltage that occurs randomly in the AC sine wave.

true power - the power dissipated in the resistance of the circuit or the power actually used by the circuit.

turn - one complete loop of a conductor about a core.

turns ratio - the ratio of number of turns in the primary winding to the number of turns in the secondary winding of a transformer.

two-capacitor motor - an induction motor using two capacitors to develop the starting phase shift. One is the start capacitor, which is taken out of the circuit by a centrifugal switch. The other capacitor is the run capacitor, which remains in the system at all times.

undercompounded - a compound wound DC machine with the emphasis on the shunt winding.

unidirectional - in one direction only.

unity power factor - when all the generated power in a system is being used to drive loads. The voltage and current waves are in phase. Unity is expressed as a power factor of 1 (100 percent efficiency).

universal time constant - a chart used to find the time constant of a circuit if the impressed voltage and the values of R and C or R and L are known.

valence - the measure of the extent to which an atom is able to combine directly with other atoms. It is believed to depend on the number and arrangement of the electrons in the outermost shell of the atom.

valence shell - the electrons that form the outermost shell of an atom.

variable resistor - a wire-wound or composition resistor, the value of which may be changed.

vector - a line used to represent both direction and magnitude; the angular difference in the direction the conductors which are moving in relation to the magnetic lines of flux.

volt - the unit of electromotive force or electrical pressure; 1 volt is the pressure required to send 1 ampere of current through a resistance of 1 ohm.

voltage - signifies electrical pressure. Voltage is a force that causes current to flow through an electrical conductor. The voltage of a circuit is the greatest effective difference of potential between any two conductors in the circuit.

voltage divider - a series circuit in which desired portions of the source voltage may be tapped off for use in equipment.

voltage drop - the difference in voltage between two points. It is the result of the loss of electrical pressure as a current flows through a resistance.

watt - the practical unit of electrical power. It is the amount of power used when 1 ampere of DC flows through a resistance of 1 ohm.

wattage rating - a rating expressing the maximum power that a device can safely handle.

watt-hour - a practical unit of electrical energy equal to one watt of power for one hour.

wattmeter - a device used to measure electrical power.

waveform - the shape of the wave obtained when instantaneous values of an AC quantity are plotted against time in a rectangular coordinate.

wavelength - the distance, usually expressed in meters, traveled by a wave during the time interval of one complete cycle. It equals the velocity of light divided by the frequency.

Weber's theory - a theory of magnetism that assumes that all magnetic material is composed of many tiny magnets. A piece of magnetic material that is magnetized has all of the tiny magnets aligned so that the north pole of each magnet points in one direction.

windage - rotational losses in a generator that are due to the friction as the armature or rotor passes through the surrounding air.

wire - a solid or stranded group of solid cylindrical conductors having a low resistance to current flow, with any associated insulation.

wiring diagram - a diagram intended to show as closely as possible the placement and actual connections of electrical devices.

work - the product of force and motion.

working voltage - the maximum voltage that a capacitor may operate at without the risk of damage.

wye or star connection - an electrical connection in three-phase machines where all terminals having the same instantaneous polarity are joined at the neutral junction. It is shown as coils connected to form a symbol resembling the letter Y.

wye-delta - a transformer connection where the primary windings are connected wye and the secondary windings are connected delta.

wye-wye - a transformer connection where both primary and secondary windings are connected in a wye pattern.

yoke - the framework or housing in a DC motor that the field windings are attached to.